ENSO: Recent Evolution, Current Status and Predictions

Update prepared by:
Climate Prediction Center / NCEP
1 May 2023

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Recent Evolution and Current Conditions

Oceanic Niño Index (ONI)

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ENSO Alert System Status: El Niño Watch

ENSO-neutral conditions are observed.*

Equatorial sea surface temperatures (SSTs) are near-to-above average across most of the Pacific Ocean.

ENSO-neutral conditions are expected to continue through the Northern Hemisphere spring, followed by a 62% chance of El Niño developing during May-July 2023.*

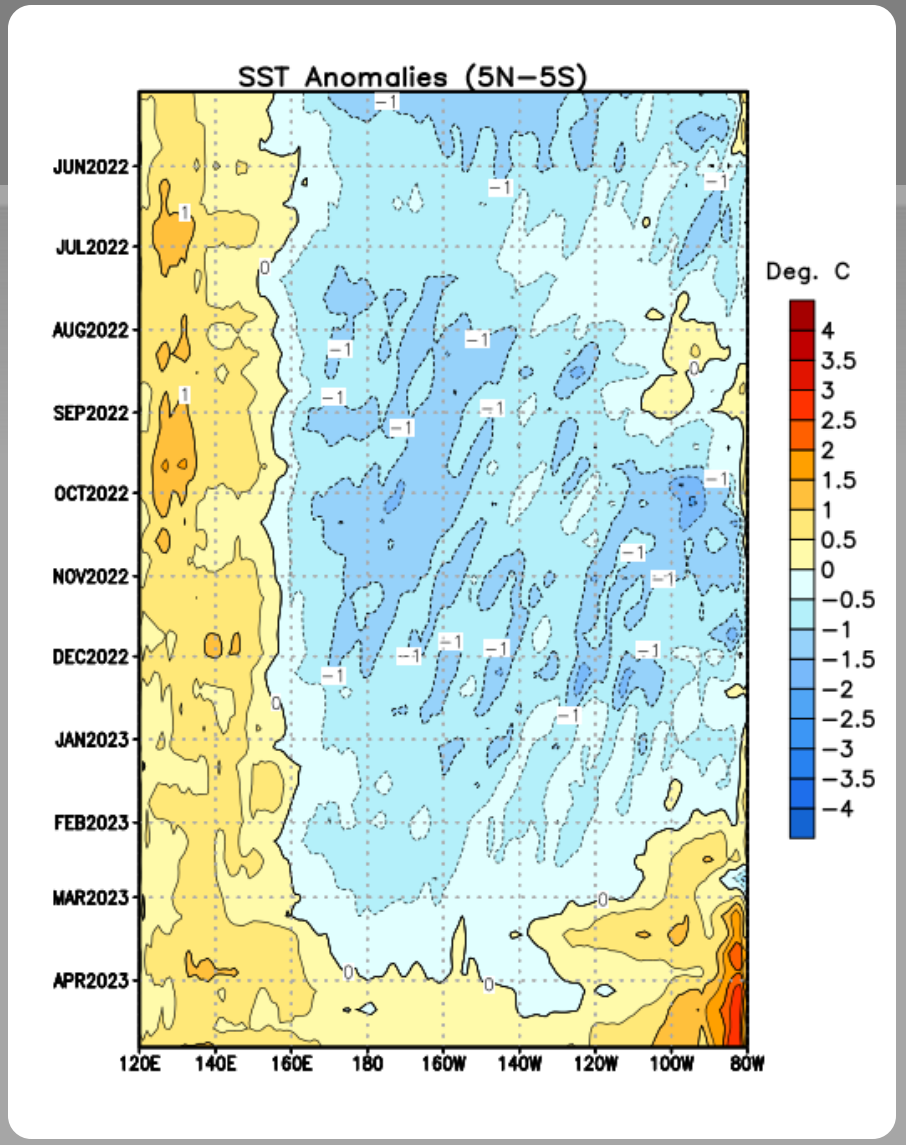
* Note: These statements are updated once a month (2nd Thursday of each month) in association with the ENSO Diagnostics Discussion, which can be found by clicking here.

Recent Evolution of Equatorial Pacific SST Departures (°C)

Negative SST anomalies gradually weakened across most of the equatorial Pacific Ocean beginning in December 2022.

Starting in January 2023, positive SST anomalies strengthened in the eastern equatorial Pacific.

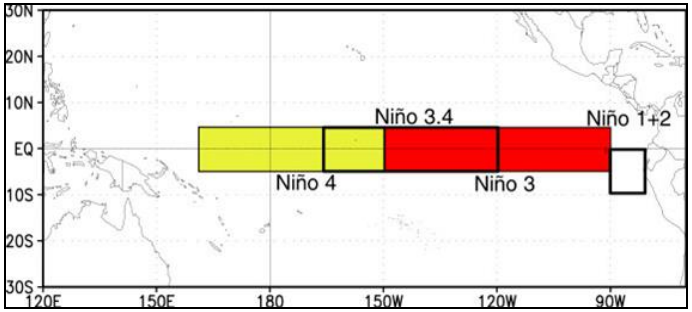
Since early April 2023, near-to-above-average SSTs have expanded across most of the tropical Pacific Ocean.

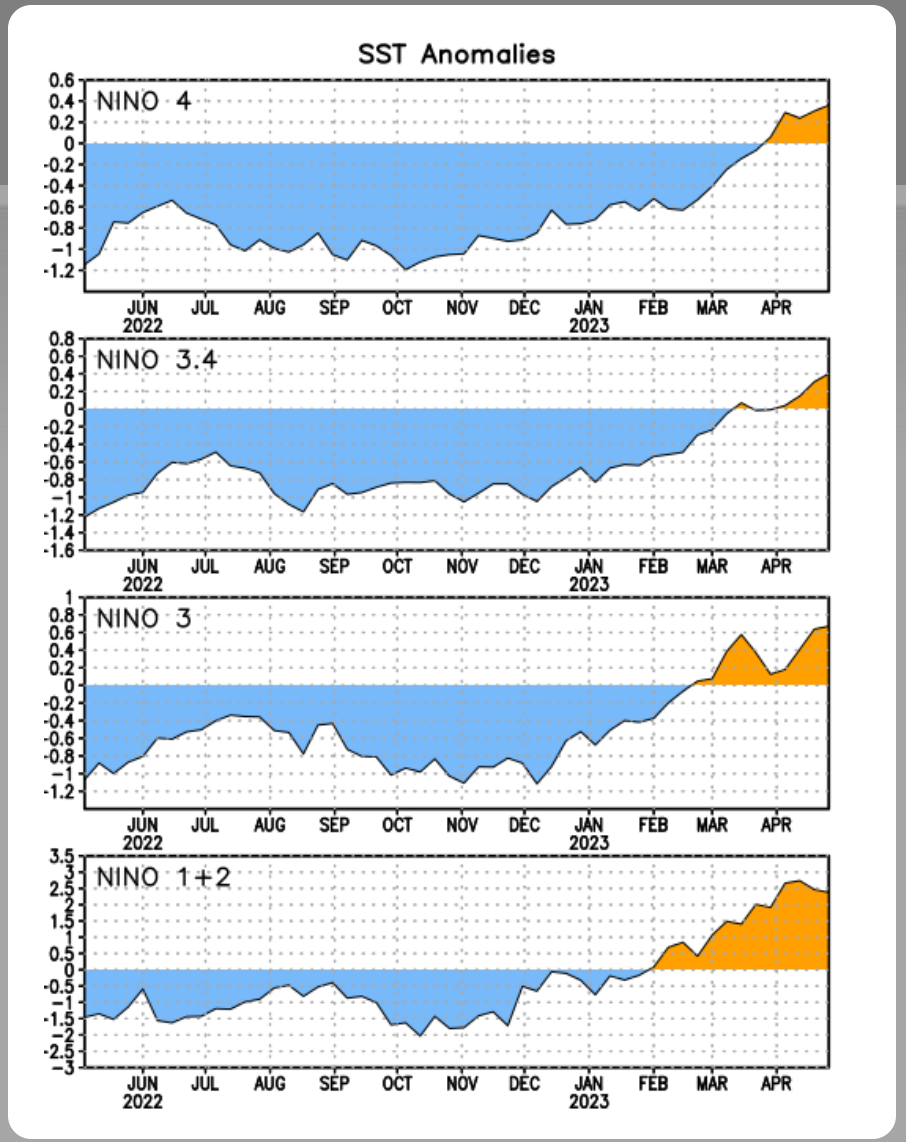


Niño Region SST Departures (ºC) Recent Evolution

The latest weekly SST departures are:

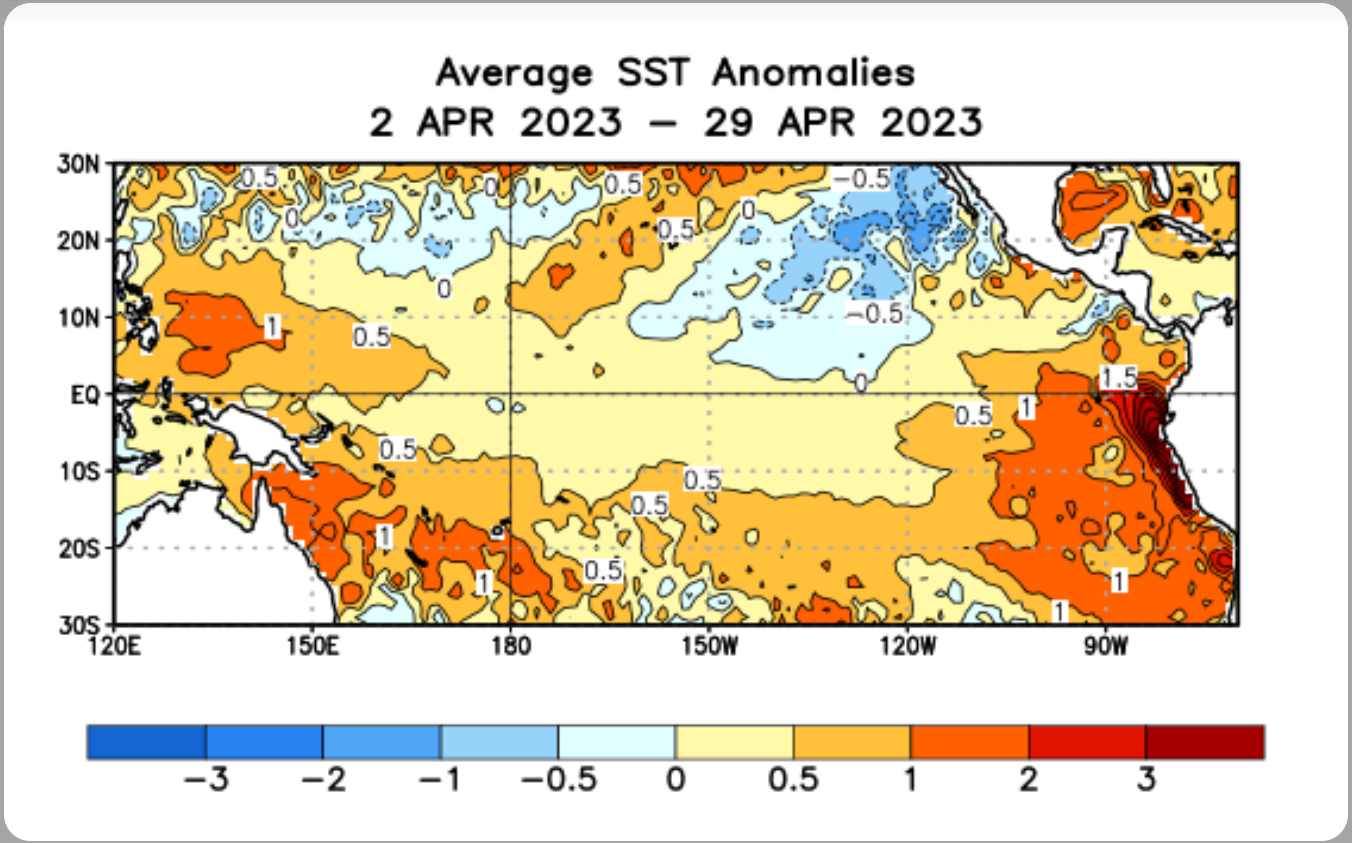
Niño 4	0.4ºC
Niño 3.4	0.4ºC
Niño 3	0.7ºC
Niño 1+2	2.4ºC





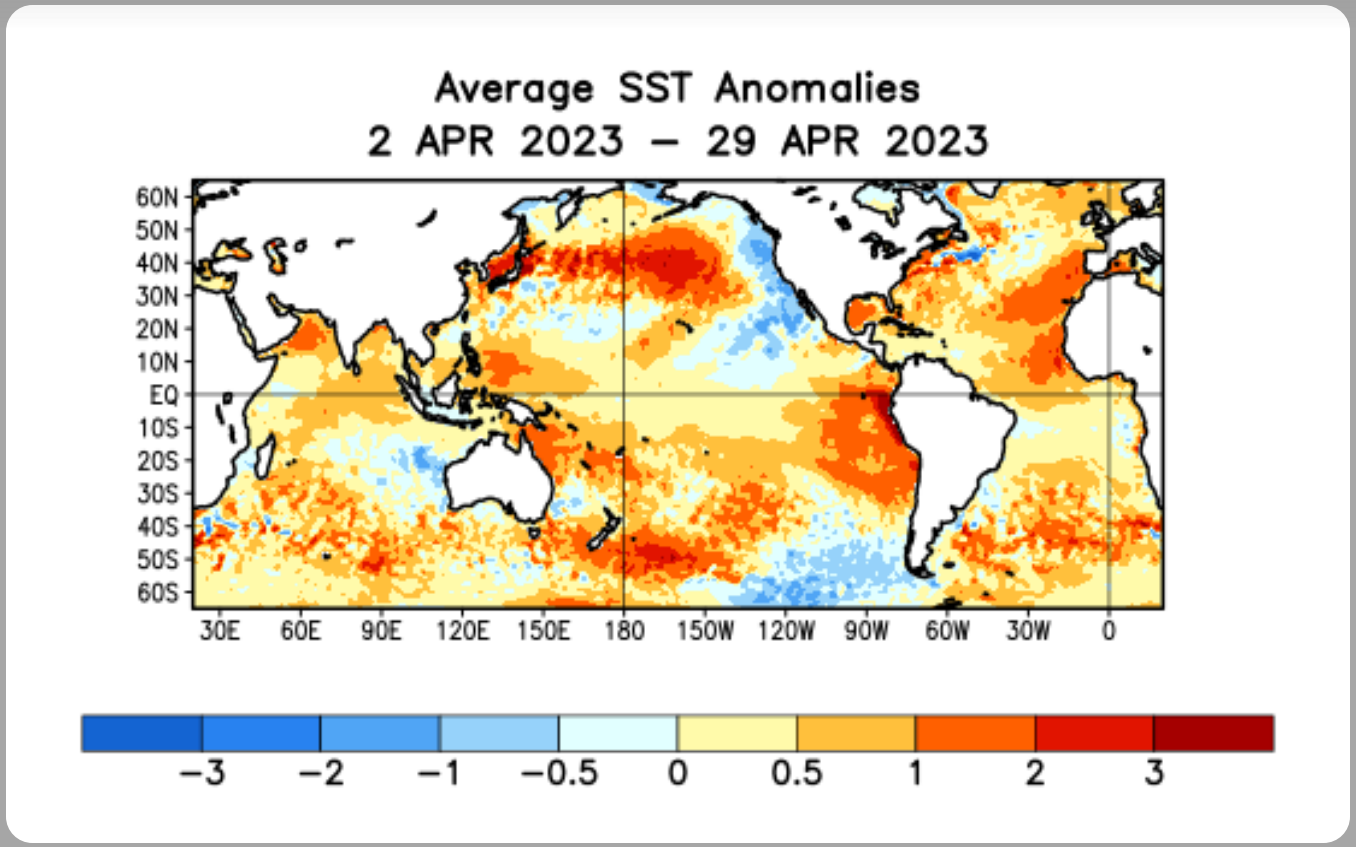
SST Departures (°C) in the Tropical Pacific During the Last Four Weeks

In the last four weeks, equatorial SSTs were above average in the eastern and western Pacific Ocean and were near average in the central and east-central Pacific Ocean.



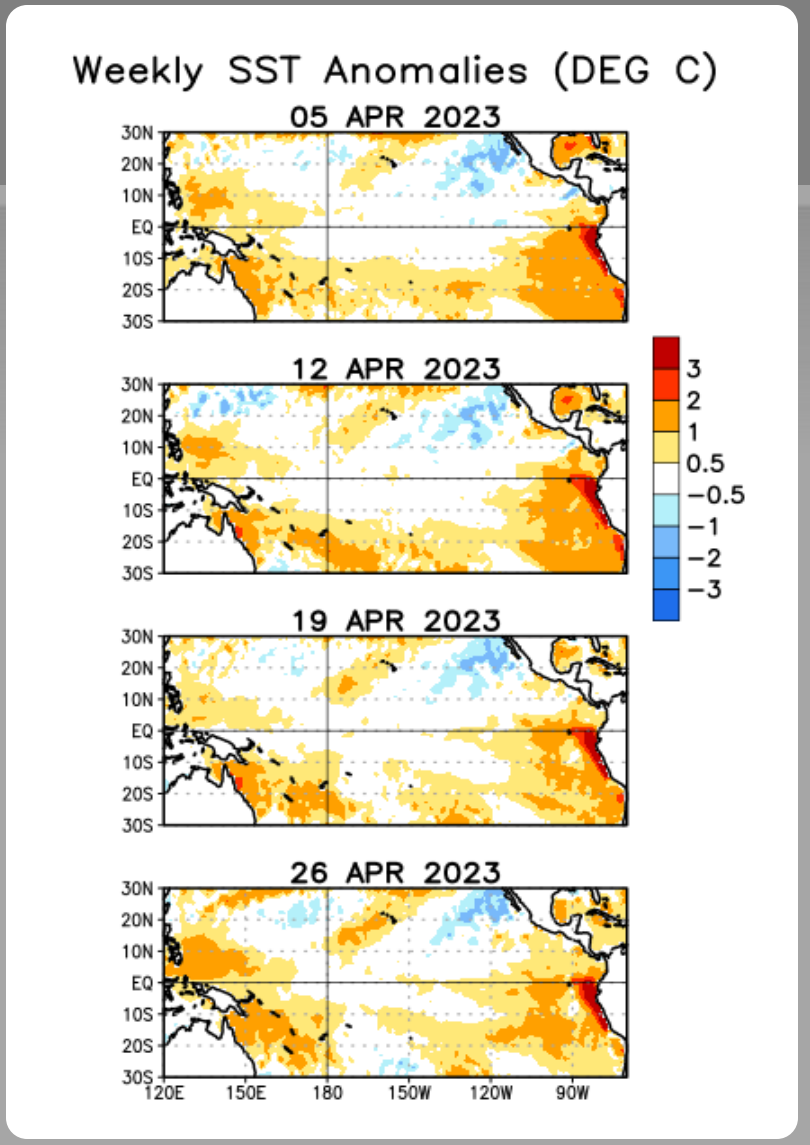
Global SST Departures (°C) During the Last Four Weeks

During the last four weeks, equatorial SSTs were above average in the eastern and western Pacific Ocean and across most of the Atlantic and Indian Oceans.



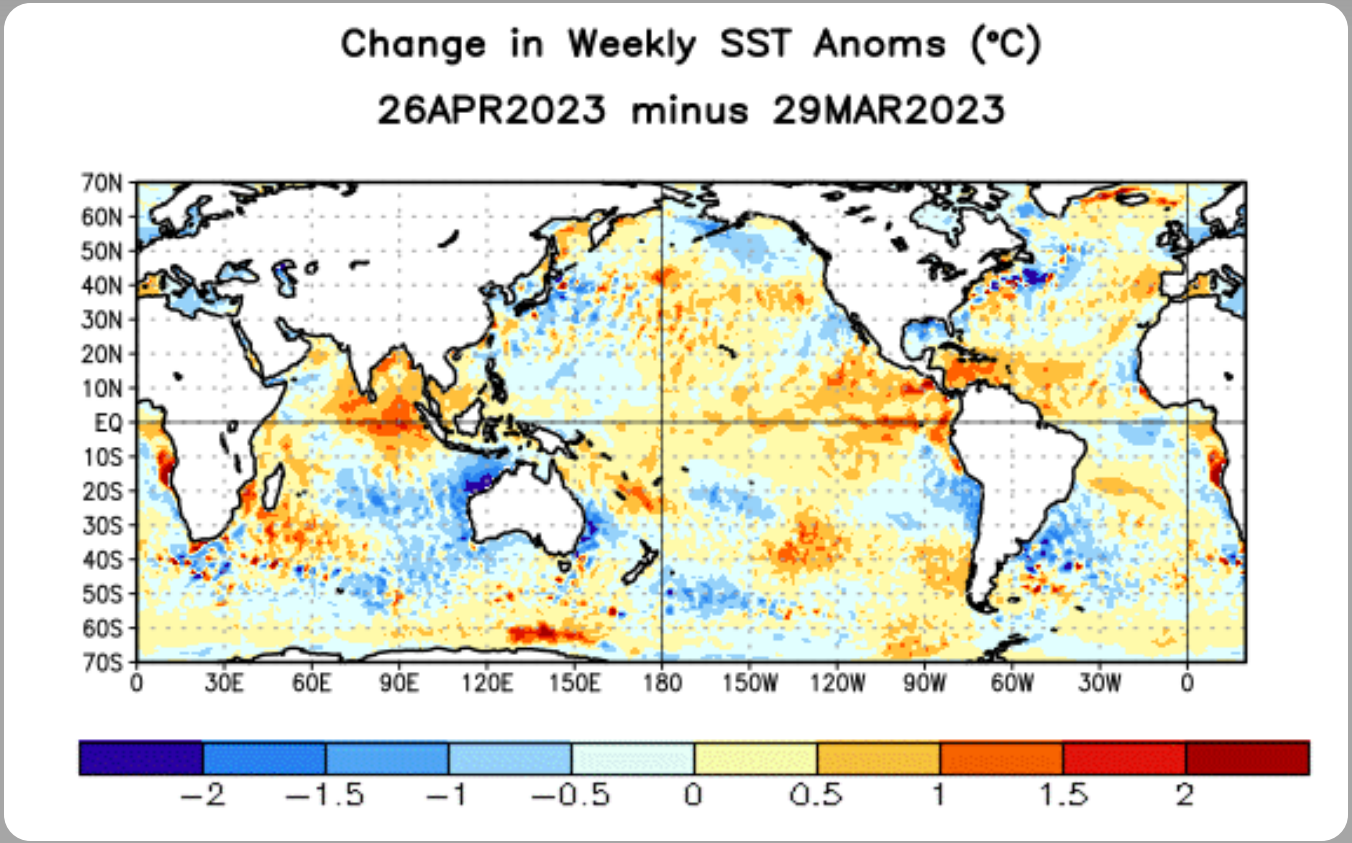
Weekly SST Departures during the Last Four Weeks

During the last 4 weeks, positive SST anomalies persisted in the western and eastern Pacific, with large anomalies near the coast of Ecuador and Peru. Near average SSTs were evident across the remainder of the equatorial Pacific.



Change in Weekly SST Departures over the Last Four Weeks

During the last four weeks, positive SST anomaly changes were evident across most of the equatorial central and eastern Pacific Ocean.



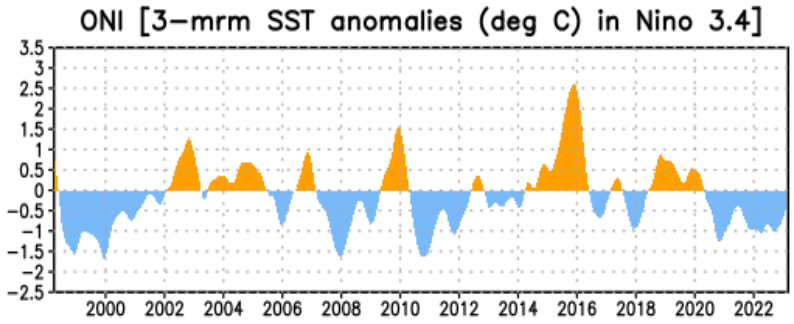
Upper-Ocean Conditions in the Equatorial Pacific

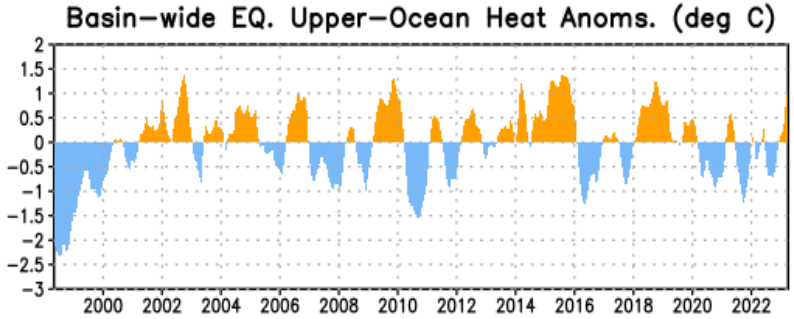
The basin-wide equatorial upper ocean (0-300 m) heat content is greatest prior to and during the early stages of a Pacific warm (El Niño) episode (compare top 2 panels), and least prior to and during the early stages of a cold (La Niña) episode.

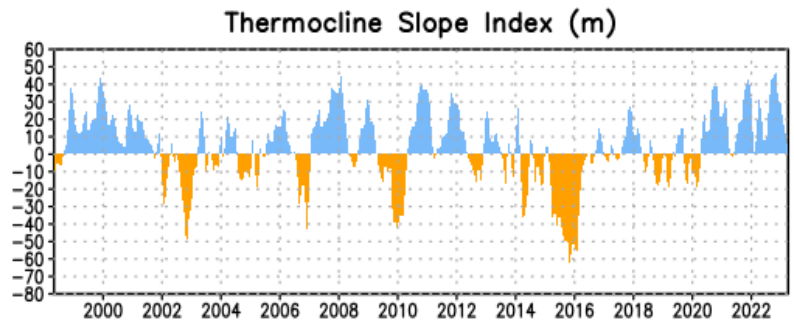
The slope of the oceanic thermocline is least (greatest) during warm (cold) episodes.

Recent values of the upper-ocean heat anomalies (above average) and thermocline slope index (above average) reflect ENSO-neutral.

The monthly thermocline slope index represents the difference in anomalous depth of the 20°C isotherm between the western Pacific (160°E-150°W) and the eastern Pacific (90°-140°W).

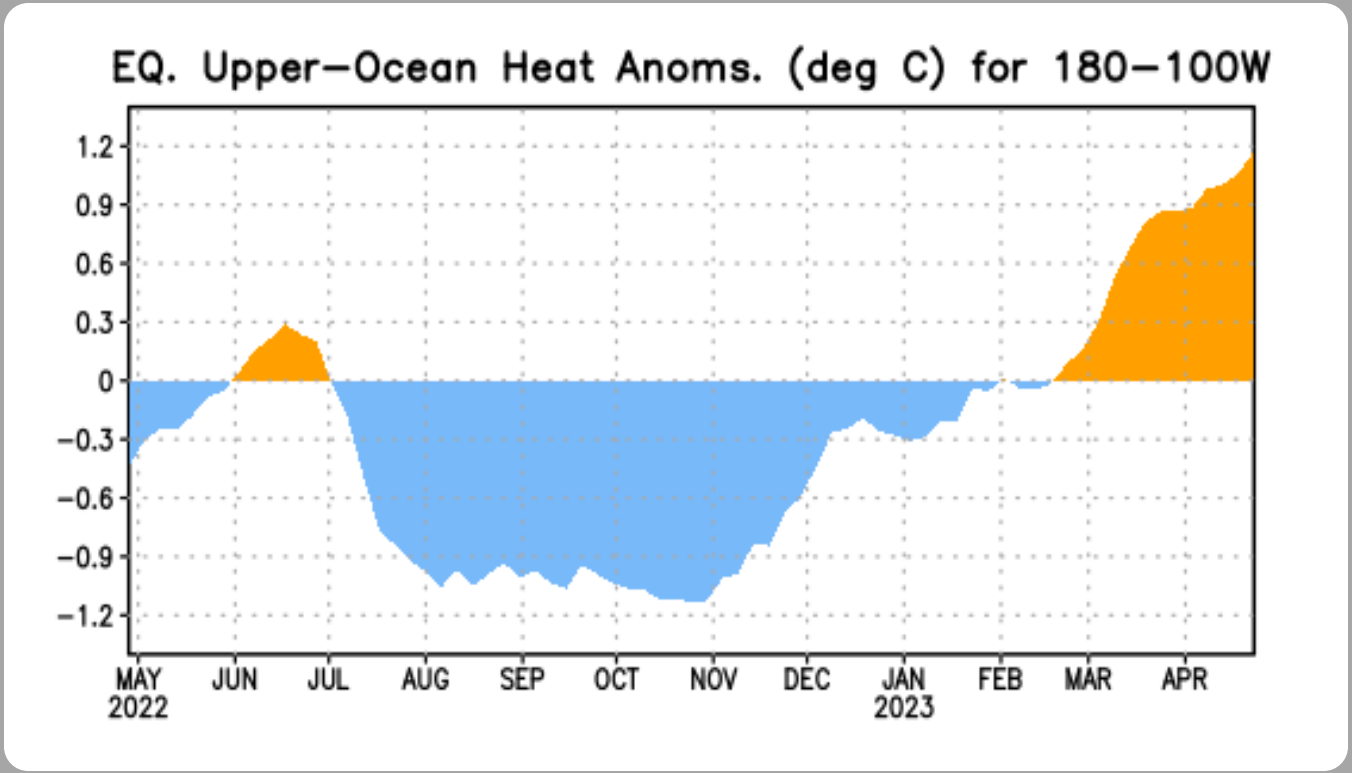






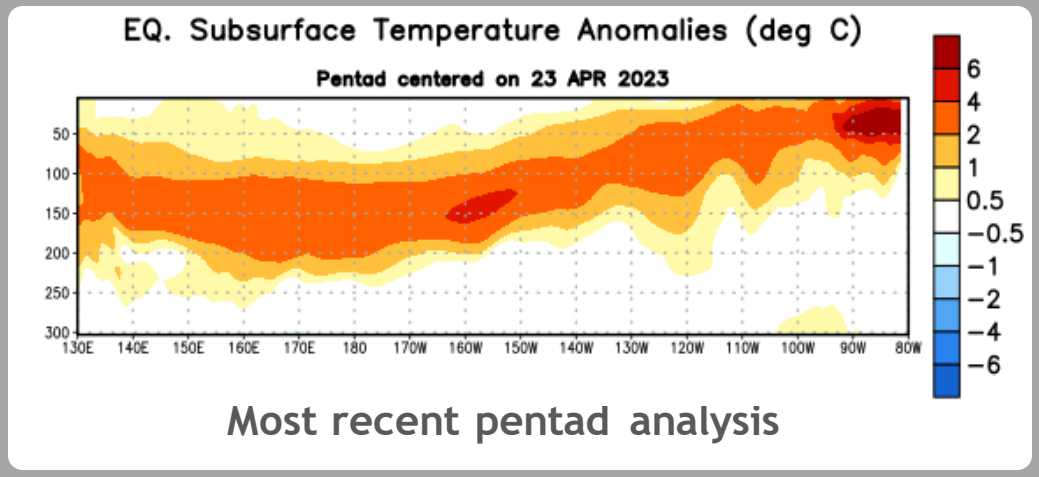
Central and Eastern Pacific Upper-Ocean (0-300 m) Weekly Average Temperature Anomalies

Subsurface temperature anomalies were negative until June 2022, before becoming briefly positive. From early July 2022 to mid-February 2023, anomalies were mostly negative. Subsurface anomalies became positive in February 2023 and have increased since then.

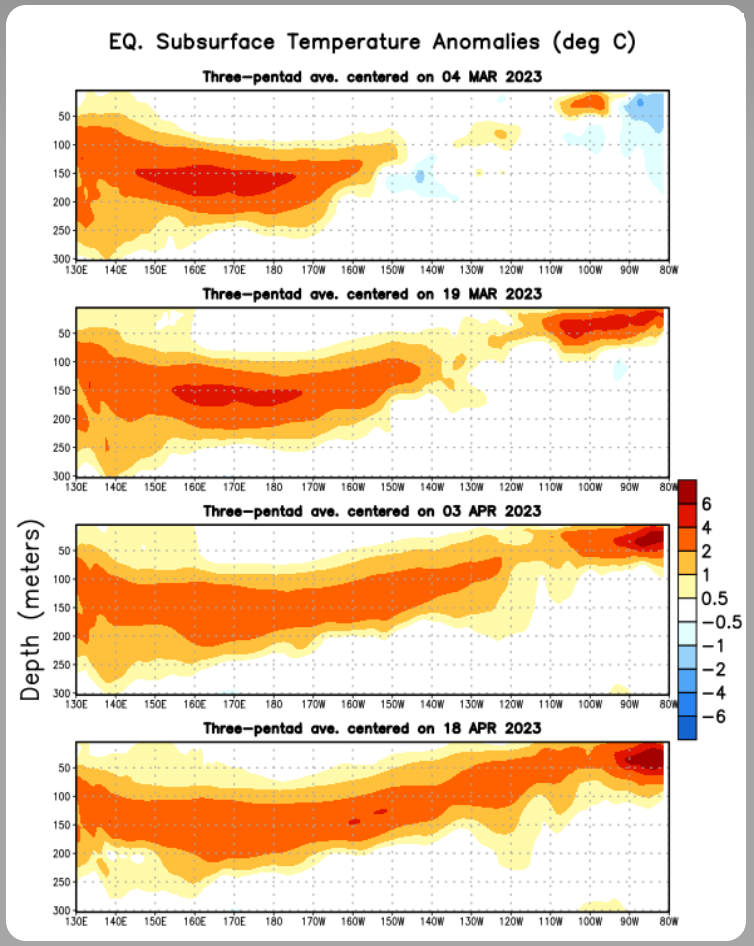


Sub-Surface Temperature Departures in the Equatorial Pacific

Positive subsurface temperature anomalies have expanded eastward and now dominate the equatorial Pacific Ocean.



Most recent pentad analysis

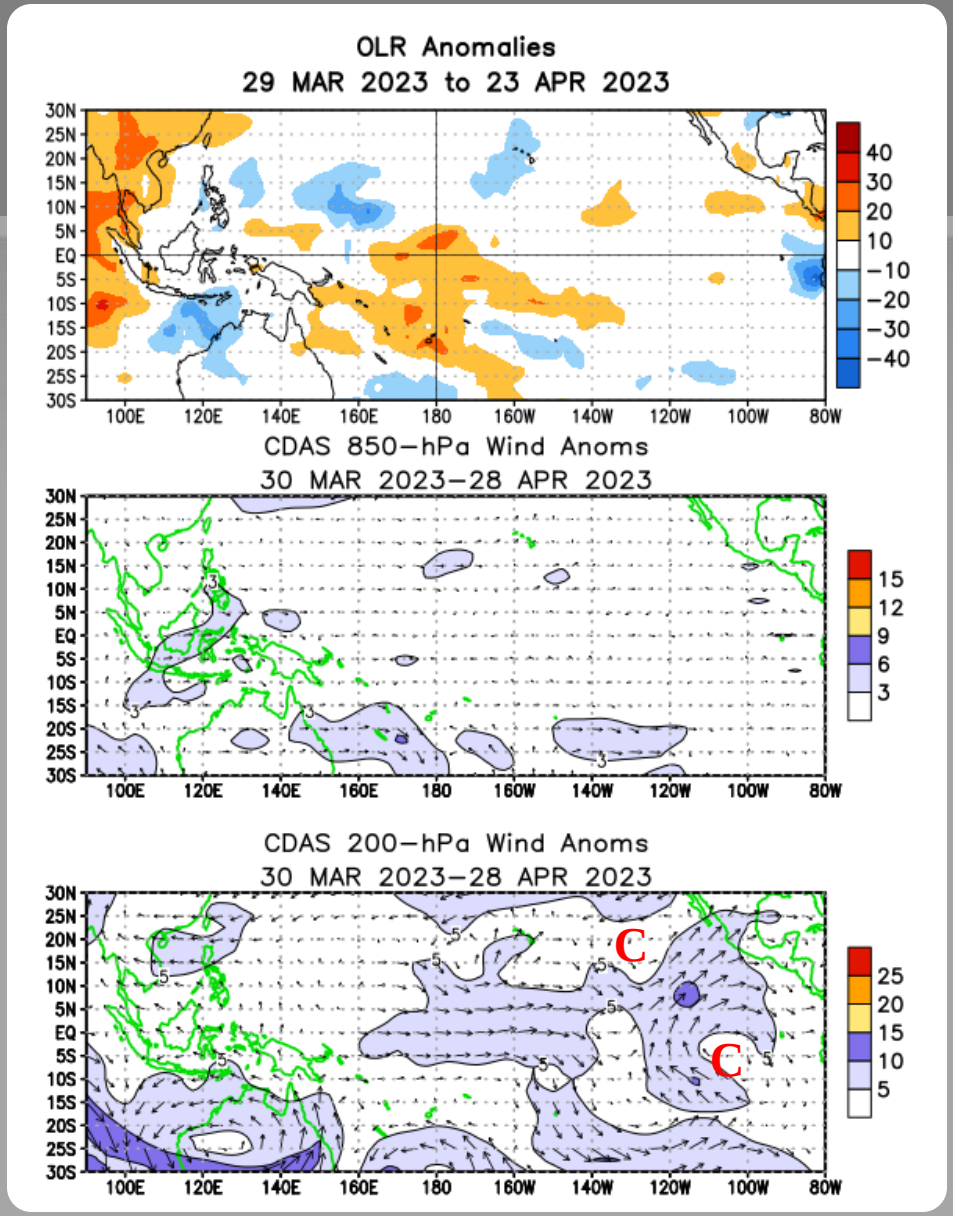


Tropical OLR and Wind Anomalies During the Last 30 Days

Weak, positive OLR anomalies (suppressed convection and precipitation) were located near the Date Line. Small regions of negative OLR anomalies were evident around Indonesia and the Philippines.

Low-level (850-hPa) winds were near average across most of the equatorial Pacific Ocean.

Upper-level (200-hPa) wind anomalies were westerly over much of the tropical Pacific, along with anomalous cyclones on either side of the equator over the eastern Pacific Ocean.



Intraseasonal Variability

Intraseasonal variability in the atmosphere (wind and pressure), which is often related to the Madden-Julian Oscillation (MJO), can significantly impact surface and subsurface conditions across the Pacific Ocean.

Related to this activity:

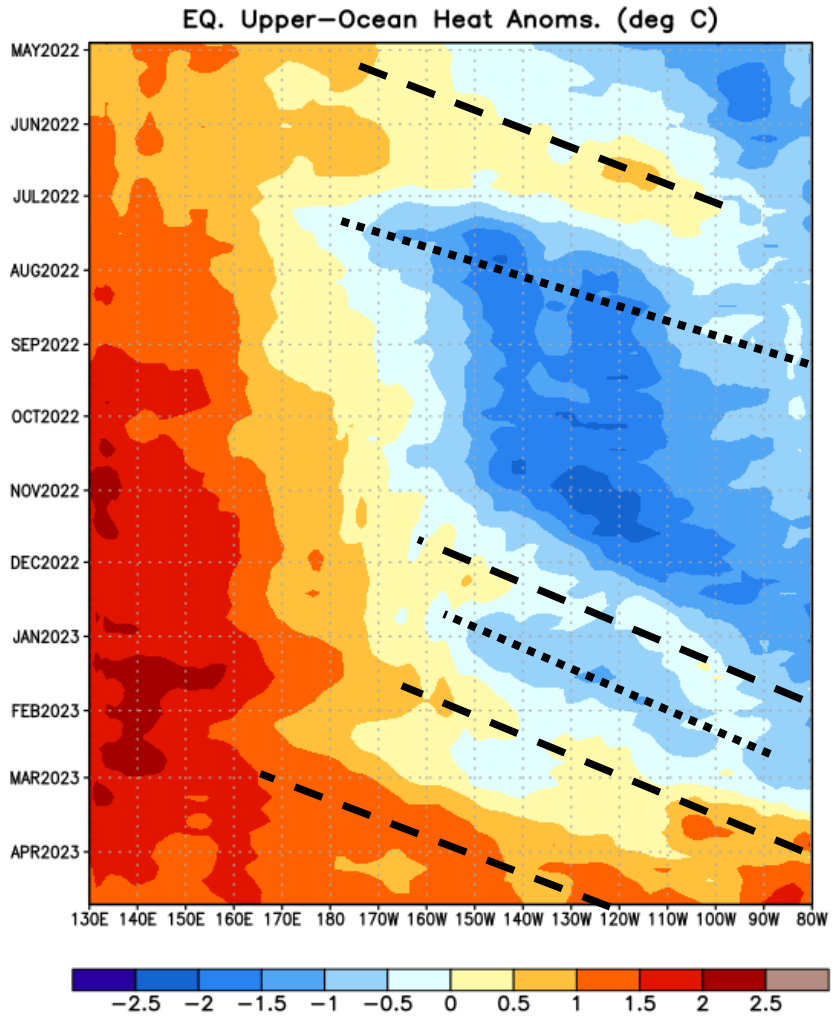
Significant weakening of the low-level easterly winds usually initiates an eastward-propagating oceanic Kelvin wave.

Weekly Heat Content Evolution in the Equatorial Pacific

Significant equatorial oceanic Kelvin wave activity (dashed and dotted lines) has been present throughout the period shown.

From August through November 2022, negative subsurface temperature anomalies persisted in the east-central and eastern Pacific Ocean.

Since late November 2022, three downwelling Kelvin waves have occurred. Since March 2023, above-average subsurface temperature anomalies have persisted across the Pacific Ocean.



Equatorial oceanic Kelvin waves have alternating warm and cold phases. The warm phase is indicated by dashed lines. Down-welling and warming occur in the leading portion of a Kelvin wave, and up-welling and cooling occur in the trailing portion.

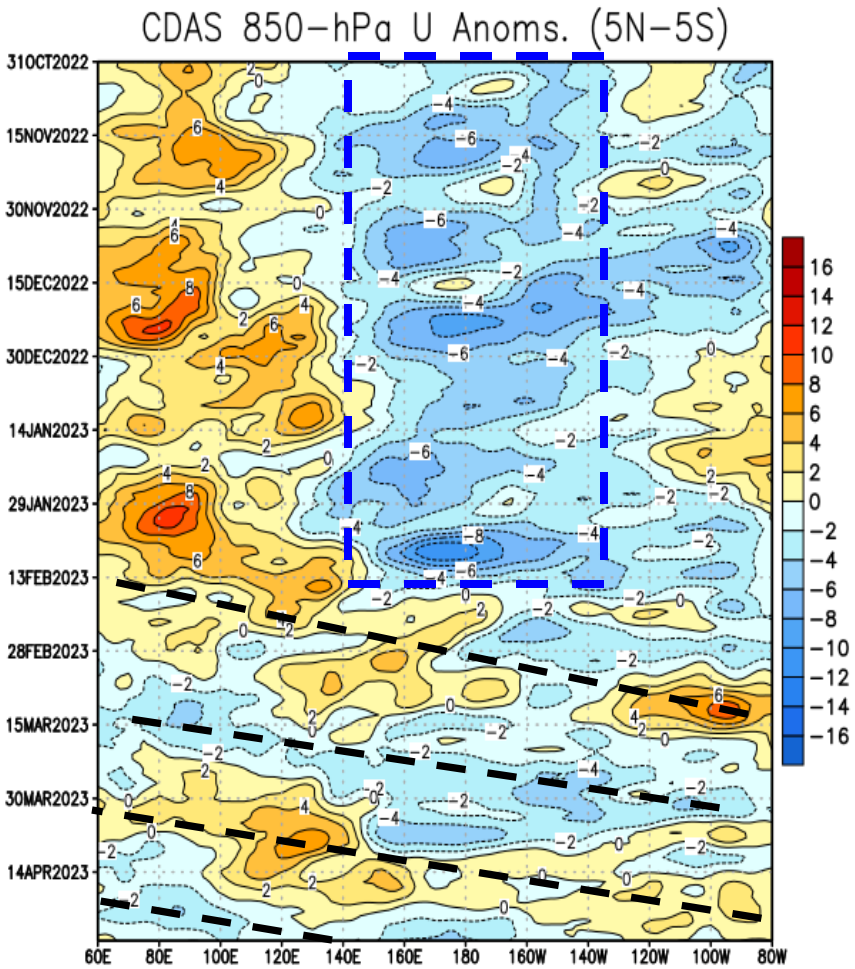
Low-level (850-hPa) Zonal (east-west) Wind Anomalies (m s^{-1})

At times, the Madden Julian-Oscillation (MJO) has contributed to the eastward propagation of low-level wind anomalies.

From the beginning of the period to mid-February 2023, easterly wind anomalies dominated the equatorial Pacific Ocean.

Since late February 2023, two episodes of westerly wind anomalies have been observed across the Pacific Ocean.

An eastward propagating pattern of westerly and easterly wind anomalies has been evident since late February 2023.

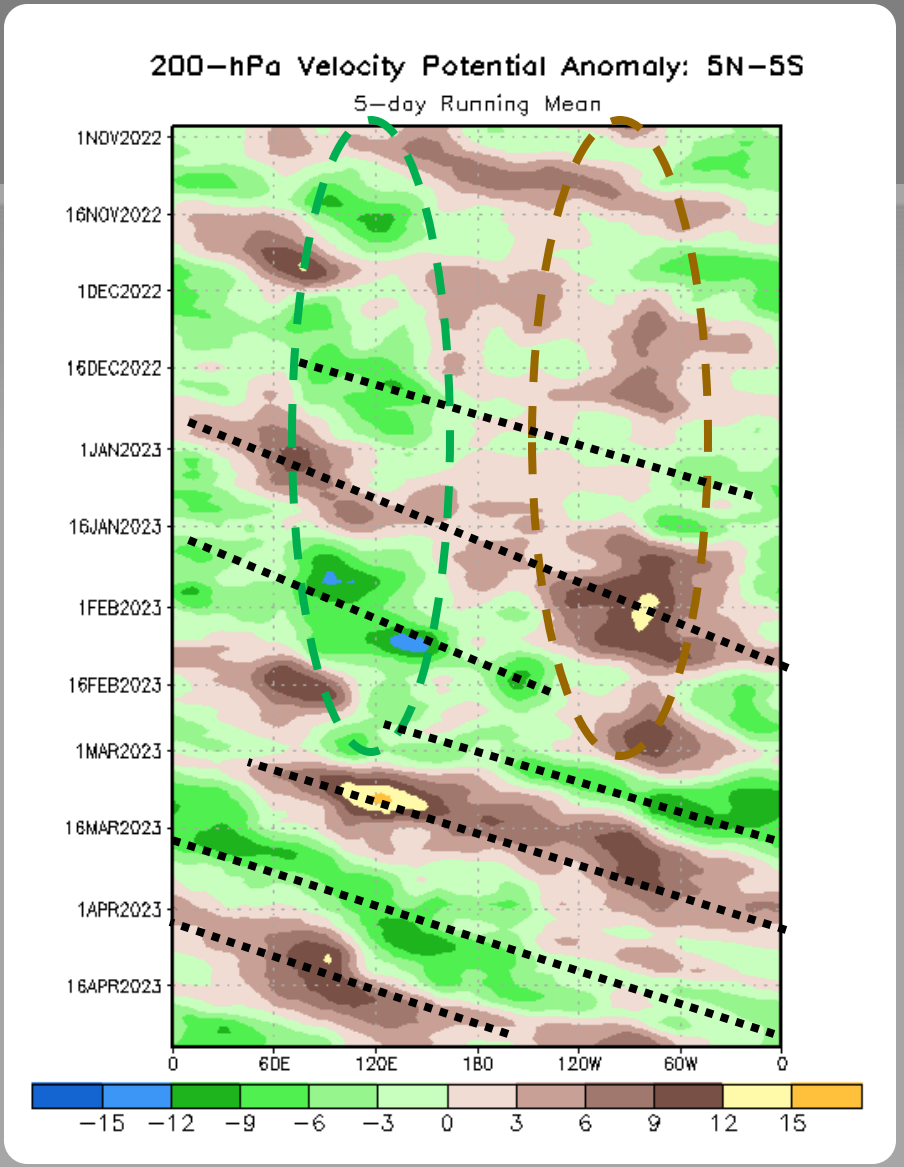


Westerly Wind Anomalies (orange/red shading)
Easterly Wind Anomalies (blue shading)

Upper-level (200-hPa) Velocity Potential Anomalies

Through February 2023, anomalous divergence (green shading) generally remained near Indonesia, while anomalous convergence (brown shading) persisted over the eastern Pacific Ocean.

Since mid-December 2022, eastward propagation of anomalies has been evident.



Unfavorable for precipitation (brown shading)
Favorable for precipitation (green shading)

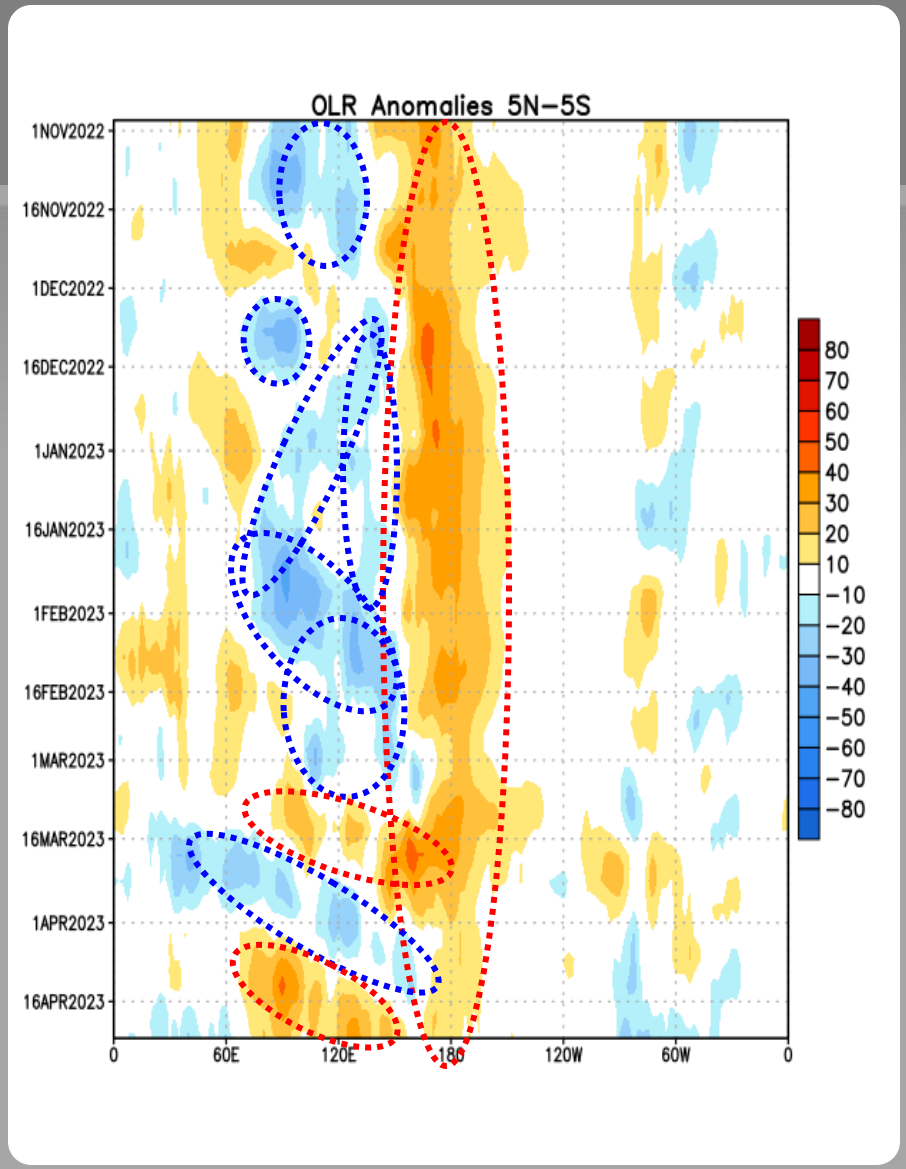
Note: Eastward propagation is not necessarily indicative of the Madden-Julian Oscillation (MJO).

Outgoing Longwave Radiation (OLR) Anomalies

Since the beginning of the period, positive OLR anomalies were evident over the western and/or central Pacific Ocean.

Negative OLR anomalies generally persisted over Indonesia through February 2023.

Since March 2023, eastward propagating OLR anomalies have been evident over Indonesia.



Drier-than-average Conditions (orange/red shading)
Wetter-than-average Conditions (blue shading)

Oceanic Niño Index (ONI)

The ONI is based on SST departures from average in the Niño 3.4 region, and is a principal measure for monitoring, assessing, and predicting ENSO.

Defined as the three-month running-mean SST departures in the Niño 3.4 region. Departures are based on a set of improved homogeneous historical SST analyses (Extended Reconstructed SST – ERSST.v5). The SST reconstruction methodology is described in Huang et al., 2017, J. Climate, vol. 30, 8179-8205.)

It is one index that helps to place current events into a historical perspective.

Note: a different SST dataset is used for weekly SST monitoring (slides #4-9) and is using OISSTv2.1 (Huang et al., 2021).

NOAA Operational Definitions for El Niño and La Niña

El Niño: characterized by a positive ONI greater than or equal to +0.5ºC.

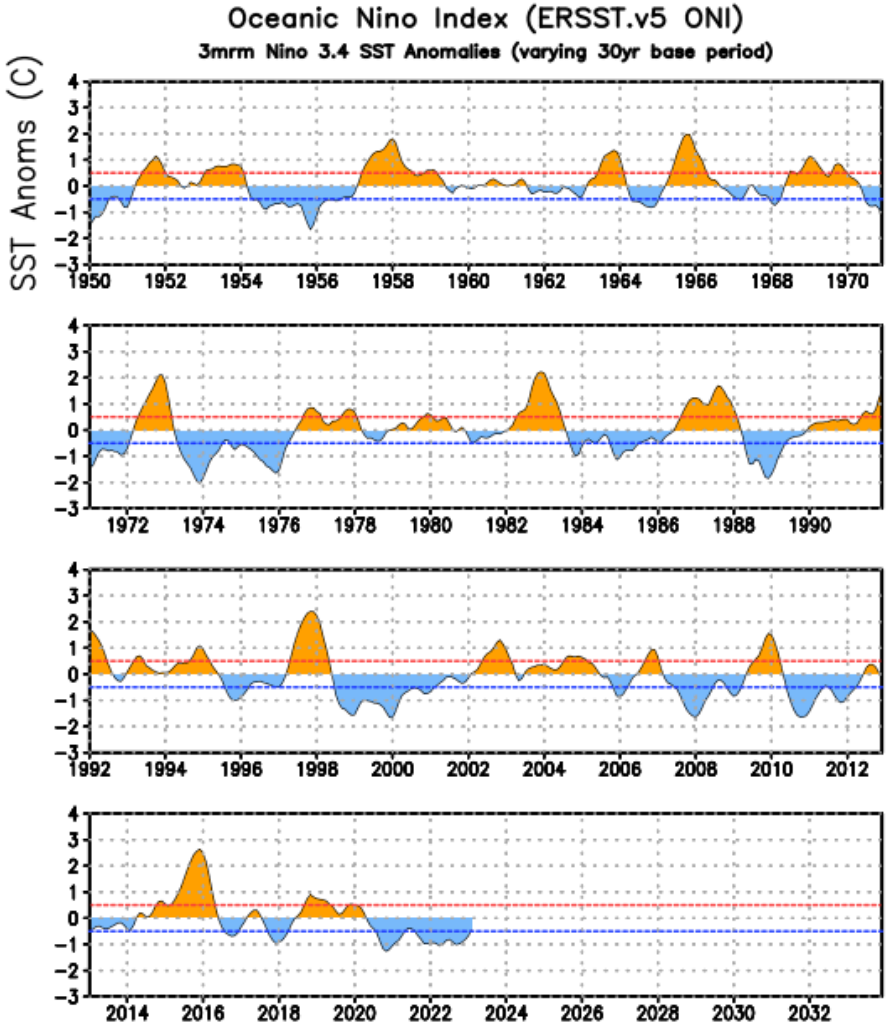
La Niña: characterized by a negative ONI less than or equal to -0.5ºC.

By historical standards, to be classified as a full-fledged El Niño or La Niña episode, these thresholds must be exceeded for a period of at least 5 consecutive overlapping 3-month seasons.

CPC considers El Niño or La Niña conditions to occur when the monthly Niño3.4 OISST departures meet or exceed +/- 0.5ºC along with consistent atmospheric features. These anomalies must also be forecasted to persist for 3 consecutive months.

ONI (°C): Evolution since 1950

The most recent ONI value (January - March 2023) is -0.4°C.



El Niño

Neutral

La Niña

Historical El Niño and La Niña Episodes Based on the ONI computed using ERSST.v5

Recent Pacific warm (red) and cold (blue) periods based on a threshold of +/- 0.5 °C for the Oceanic Nino Index (ONI) [3 month running mean of ERSST.v5 SST anomalies in the Nino 3.4 region (5N-5S, 120-170W)]. For historical purposes, periods of below and above normal SSTs are colored in blue and red when the threshold is met for a minimum of 5 consecutive over-lapping seasons.

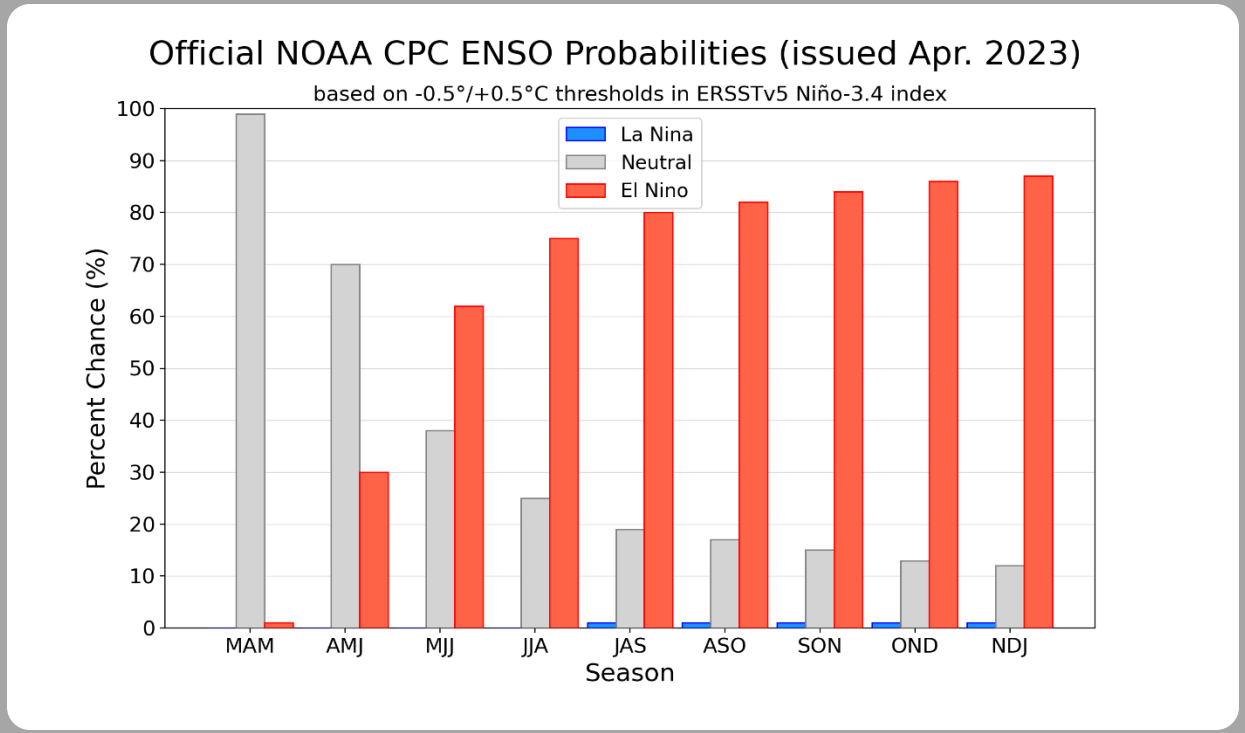
The ONI is one measure of the El Niño-Southern Oscillation, and other indices can confirm whether features consistent with a coupled ocean-atmosphere phenomenon accompanied these periods. The complete table going back to DJF 1950 can be found here.

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
2011	-1.4	-1.2	-0.9	-0.7	-0.6	-0.4	-0.5	-0.6	-0.8	-1.0	-1.1	-1.0
2012	-0.9	-0.7	-0.6	-0.5	-0.3	0.0	0.2	0.4	0.4	0.3	0.1	-0.2
2013	-0.4	-0.4	-0.3	-0.3	-0.4	-0.4	-0.4	-0.3	-0.3	-0.2	-0.2	-0.3
2014	-0.4	-0.5	-0.3	0.0	0.2	0.2	0.0	0.1	0.2	0.5	0.6	0.7
2015	0.5	0.5	0.5	0.7	0.9	1.2	1.5	1.9	2.2	2.4	2.6	2.6
2016	2.5	2.1	1.6	0.9	0.4	-0.1	-0.4	-0.5	-0.6	-0.7	-0.7	-0.6
2017	-0.3	-0.2	0.1	0.2	0.3	0.3	0.1	-0.1	-0.4	-0.7	-0.8	-1.0
2018	-0.9	-0.9	-0.7	-0.5	-0.2	0.0	0.1	0.2	0.5	0.8	0.9	0.8
2019	0.7	0.7	0.7	0.7	0.5	0.5	0.3	0.1	0.2	0.3	0.5	0.5
2020	0.5	0.5	0.4	0.2	-0.1	-0.3	-0.4	-0.6	-0.9	-1.2	-1.3	-1.2
2021	-1.0	-0.9	-0.8	-0.7	-0.5	-0.4	-0.4	-0.5	-0.7	-0.8	-1.0	-1.0
2022	-1.0	-0.9	-1.0	-1.1	-1.0	-0.9	-0.8	-0.9	-1.0	-1.0	-0.9	-0.8
2023	-0.7	-0.4										

CPC Probabilistic ENSO Outlook

Updated: 13 April 2023

A transition from ENSO-neutral to El Niño is favored during May-July 2023, with chances of El Niño increasing through the fall and early winter 2023-24.



IRI Pacific Niño 3.4 SST Model Outlook

Both the dynamical and statistical models suggest a potential return to El Niño by May-July 2023, with the warming generally stronger in the dynamical models.

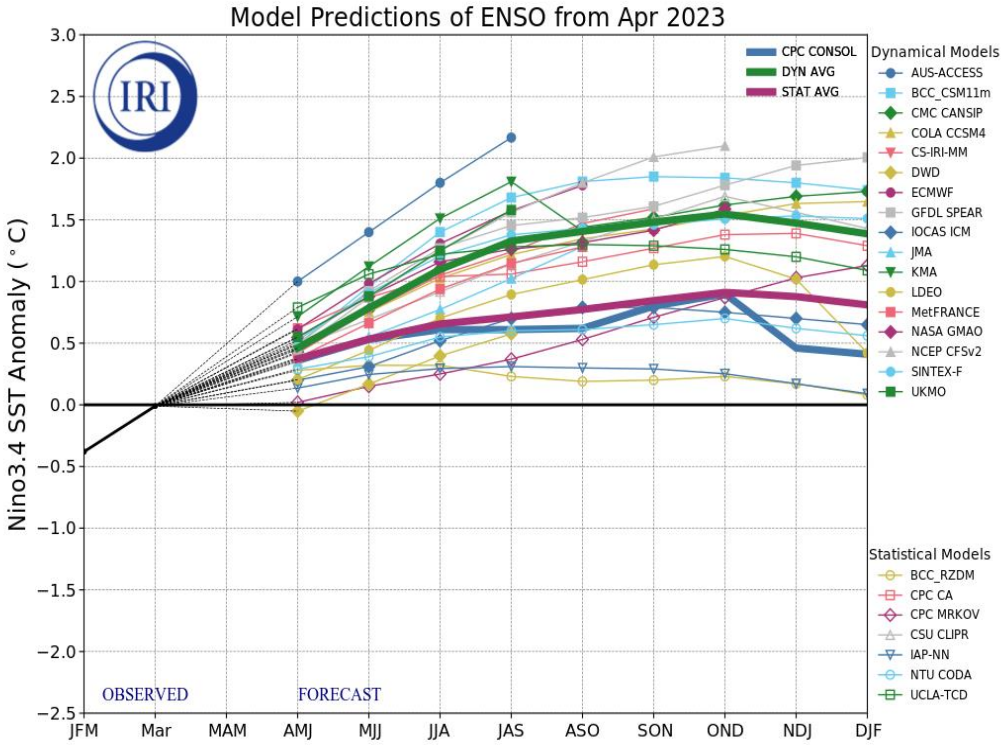
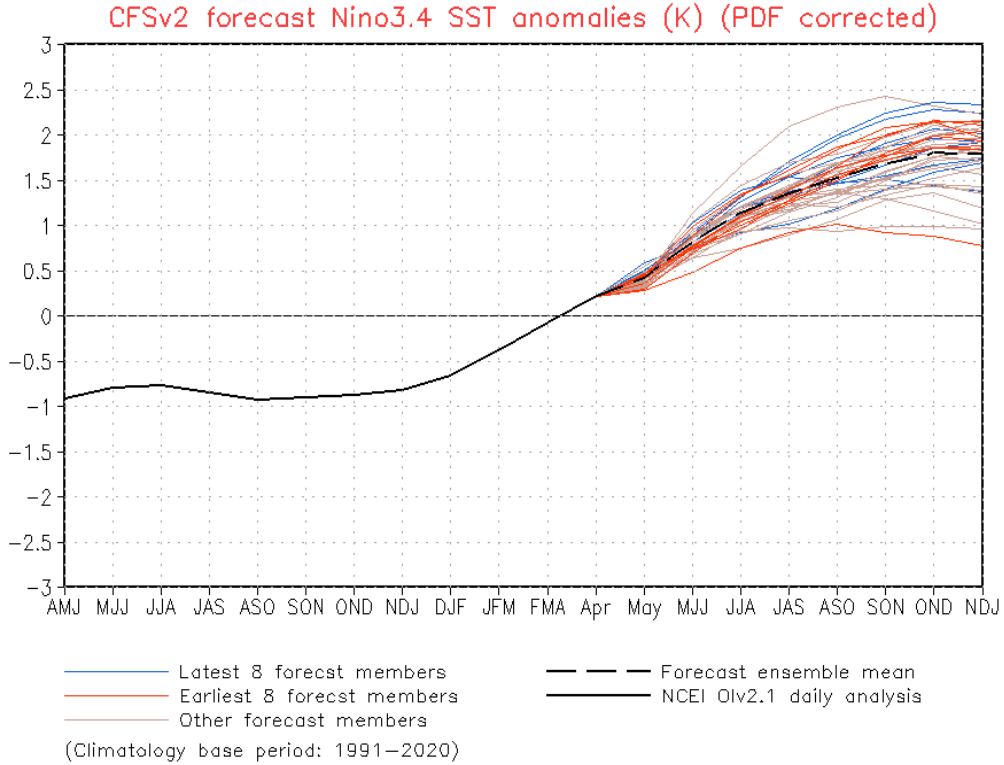


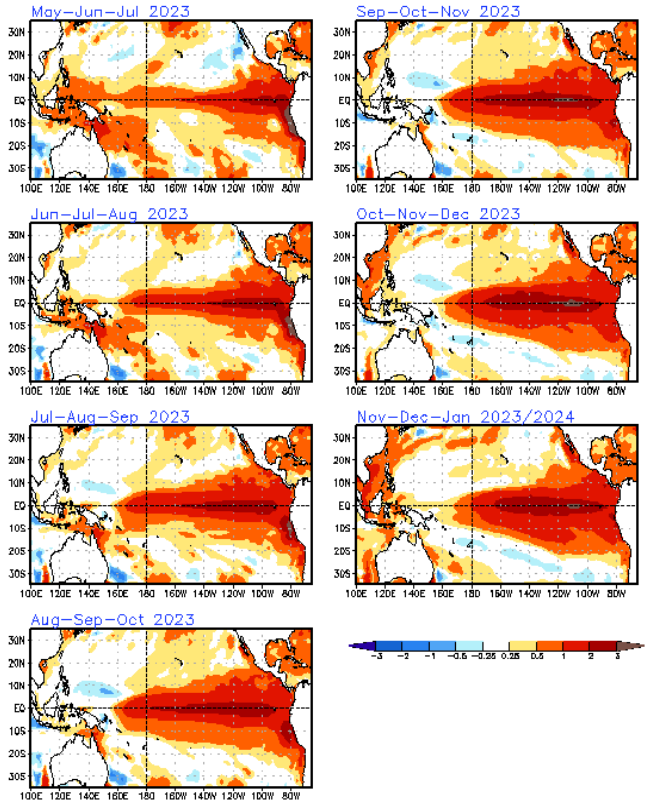
Figure provided by the International Research Institute (IRI) for Climate and Society (updated 19 April 2023).

SST Outlook: NCEP CFS.v2 Forecast (PDF corrected)

Issued: 30 April 2023

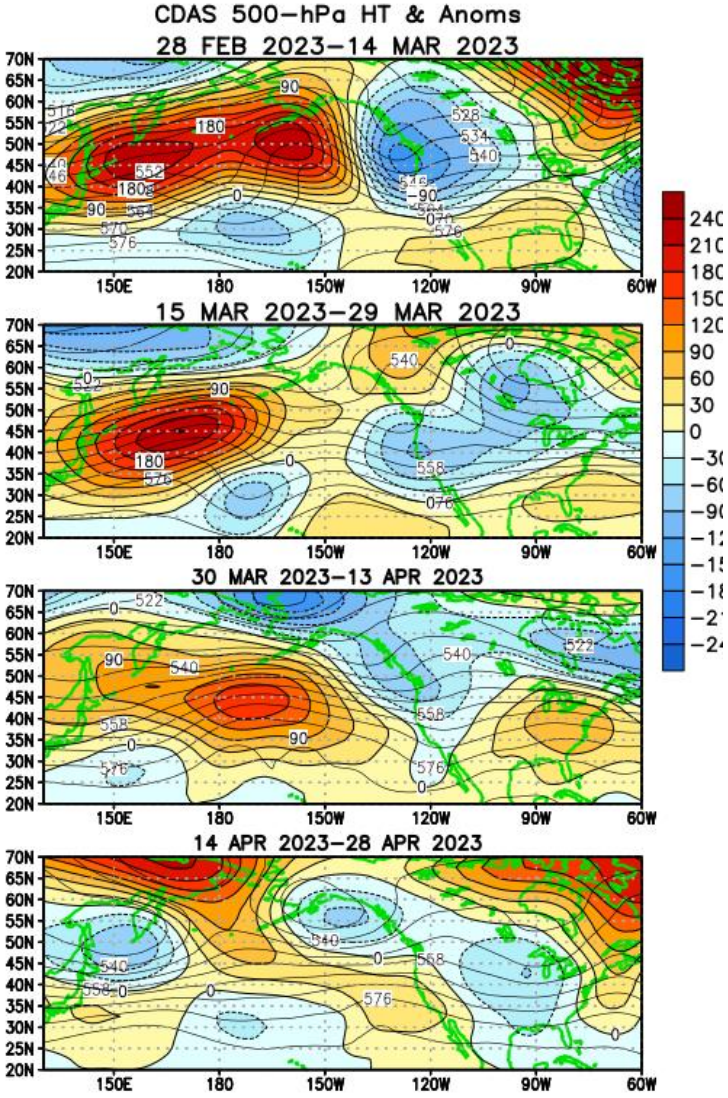
The CFS.v2 ensemble mean (black dashed line) favors a transition from ENSO-neutral to El Niño in the next few months.





Atmospheric anomalies over the North Pacific and North America During the Last 60 Days

Over most of the period, an anomalous ridge and retracted jet stream were evident over the North Pacific Ocean. A downstream anomalous trough was associated with mostly below-average temperatures over the western U.S., while above-average heights/temperatures generally persisted over the eastern U.S.



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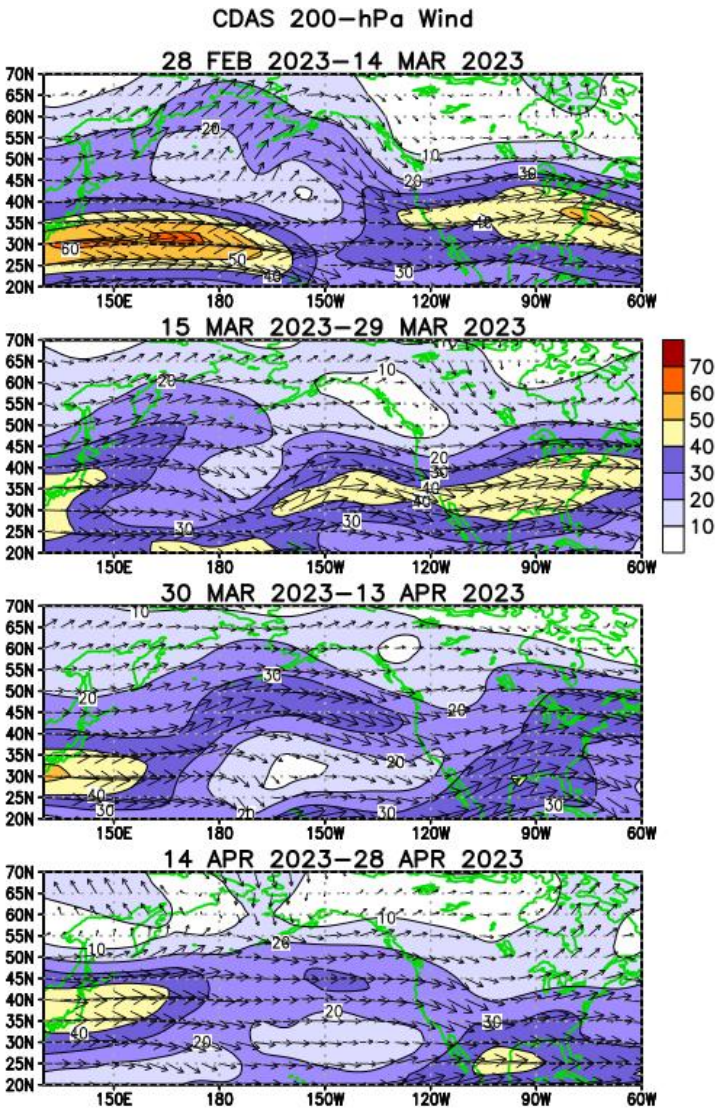

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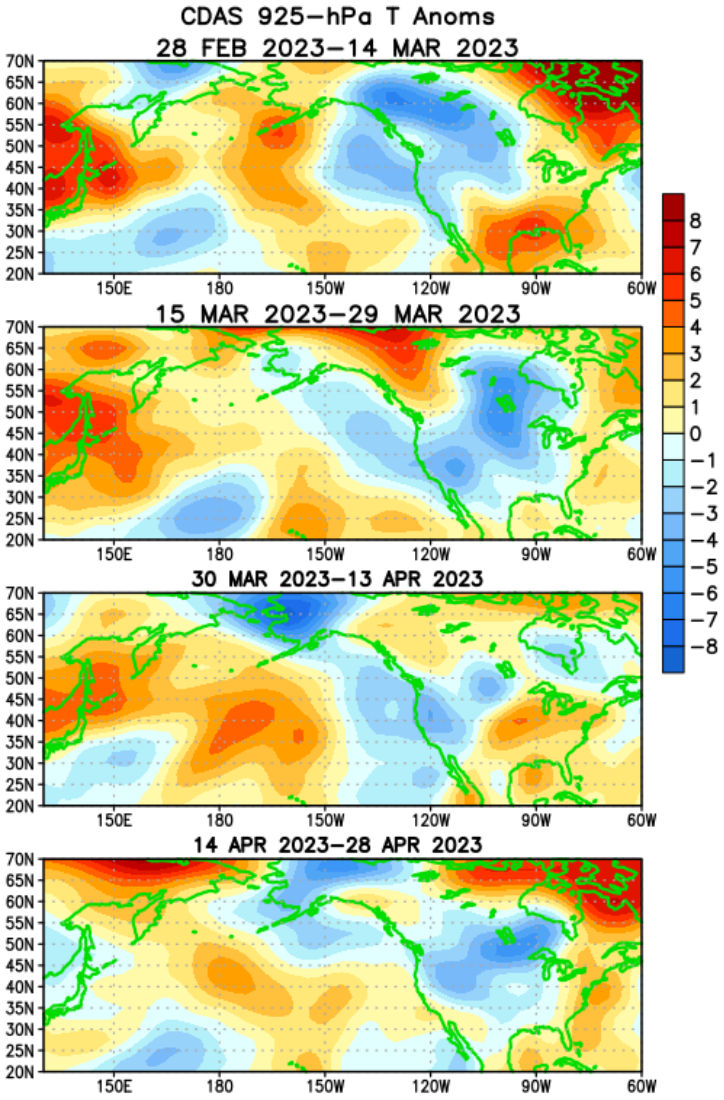
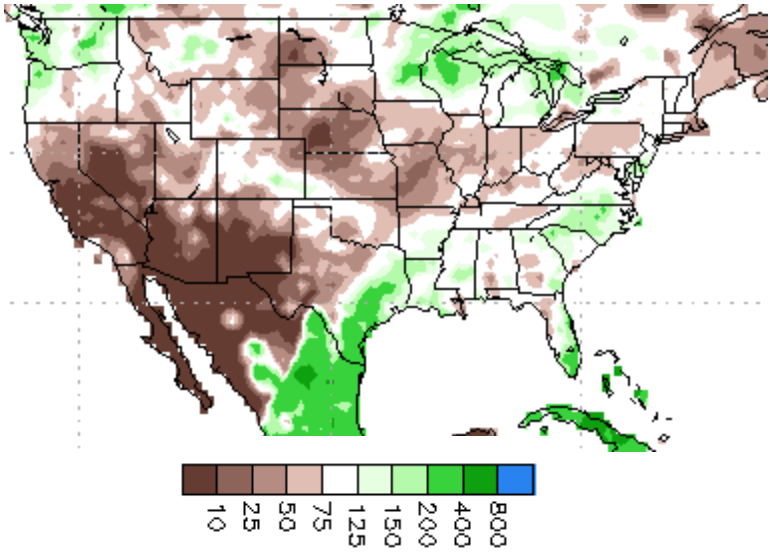


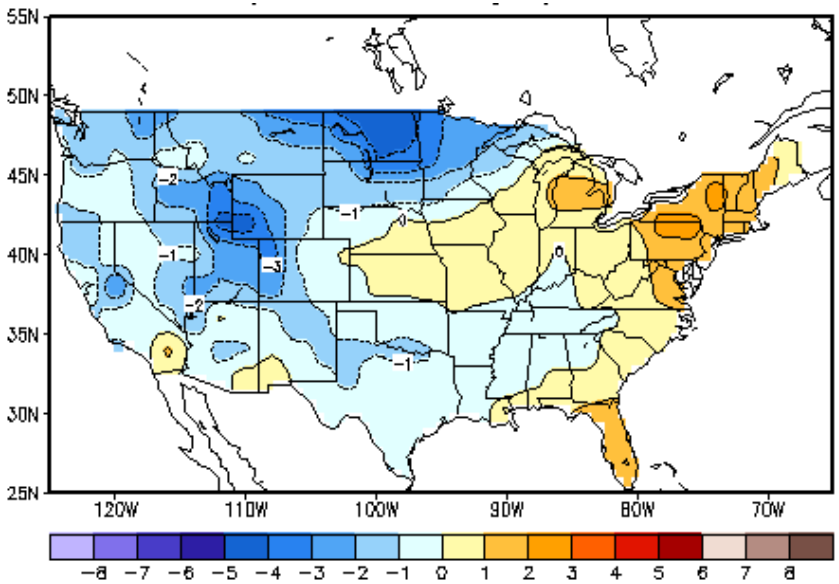
U.S. Temperature and Precipitation Departures During the Last 30 Days

End Date: 29 April 2023

Percent of Average Precipitation



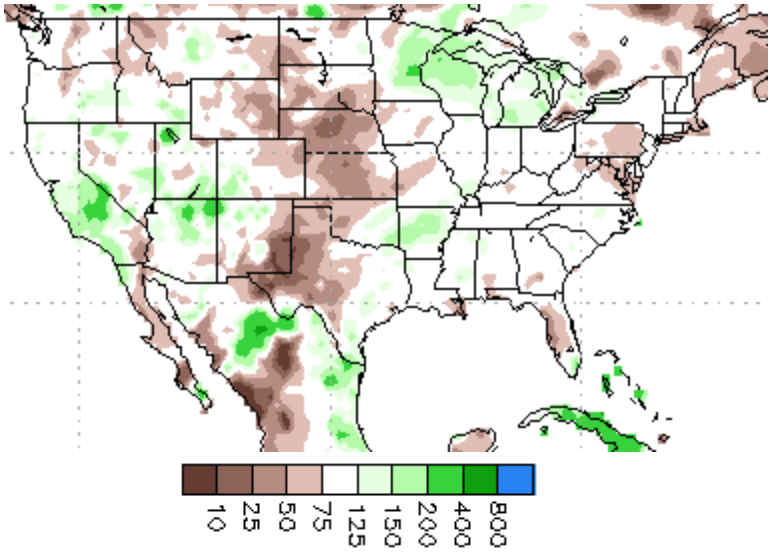
Temperature Departures (degree C)



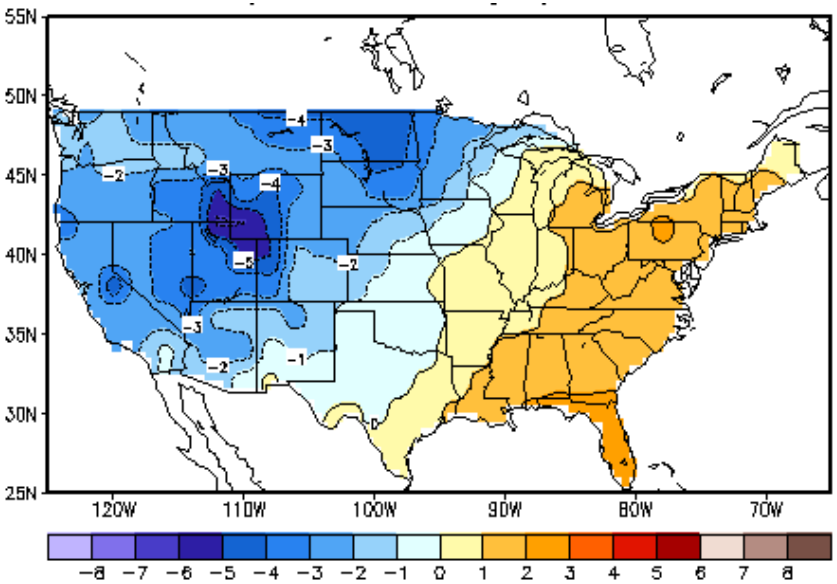
U.S. Temperature and Precipitation Departures During the Last 90 Days

End Date: 29 April 2023

Percent of Average Precipitation



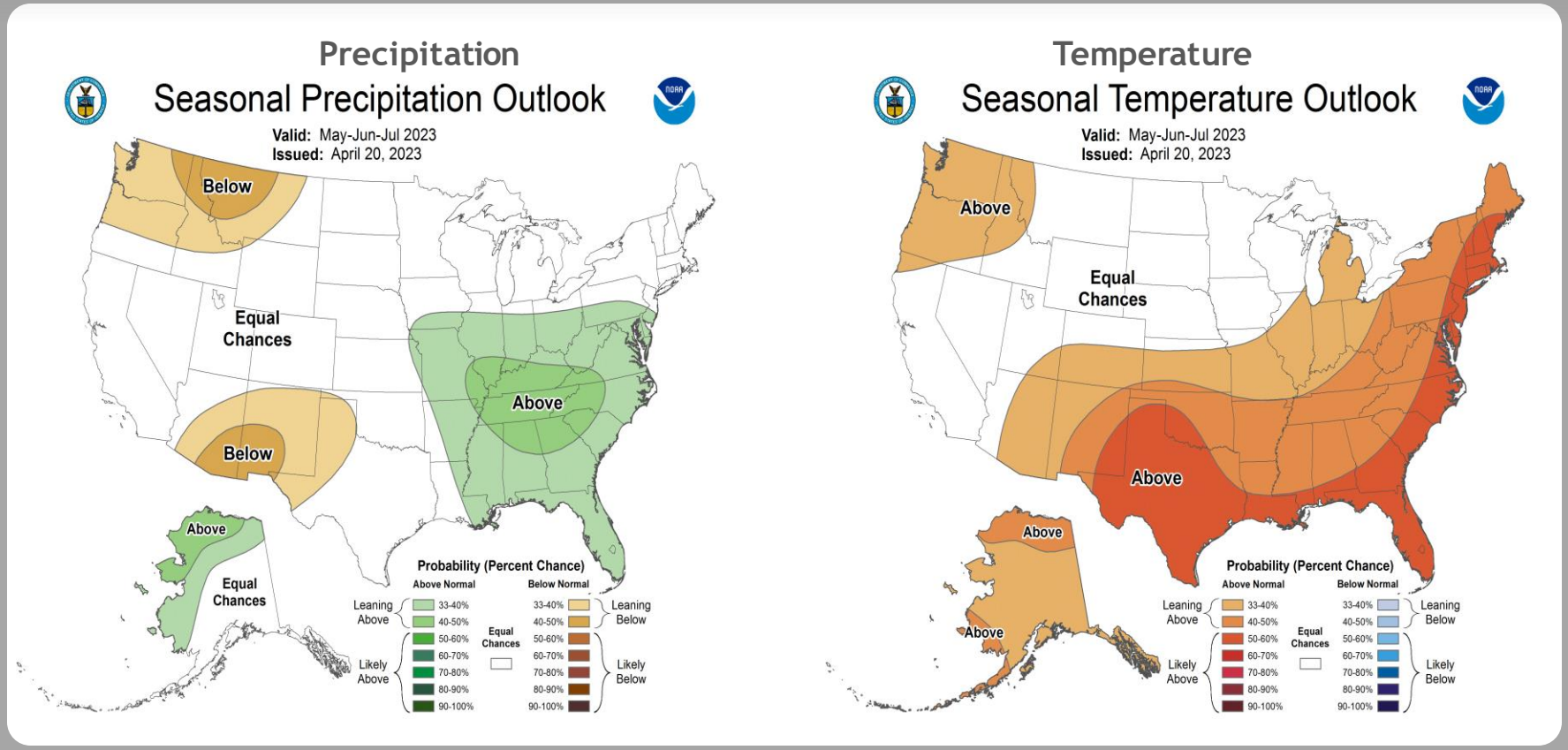
Temperature Departures (degree C)



U. S. Seasonal Outlooks

May - July 2023

The seasonal outlooks combine the effects of long-term trends, soil moisture, and, when appropriate, ENSO.



Summary

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ENSO-neutral conditions are expected to continue through the Northern Hemisphere spring, followed by a 62% chance of El Niño developing during May-July 2023.*

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